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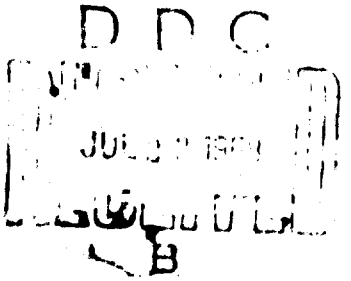

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POTASSIUM BLOOD LEVELS IN MALARIA

Translation of an article by Luigi PINELLI, Resident at the Institute of Clinical Medicine of the University of Sassari (Sardinia, Italy), published in the Italian-language Rivista di Malariologia (Malaria Studies Review), No. 8, 1929, pages 310 to 314.

Among the various organic salts, Potassium plays a not unimportant part. It is to be found, in the form of chlorides and phosphates, in the cells of the nerve and muscle fibers, and in the red corpuscles of the blood, whose ashes contain anywhere from 40% to 80%. The Potassium level in blood serum, on the other hand, is relatively low. According to various authors, it ranges from Kramer and Tinsdall, who assign it a value of 18.7-70mg%, to Olmar and Paisan, with 20-30mg%, to Klin, with 18.7 to 23.7mg%, to Desel and Katz, with 22.7-38.7mg%, to Mathemy with 17.3mg%, and to Ottonello, with 19.88 to 34.08mg%. The maximum and minimum physiological levels I found in normal individuals, all of them on the same mixed diet, showed a spread of 18.5 to 37.15mg%.

The purpose of the present inquiry was to study the behavior of Potassium in the blood of chronic malaria victims (those not subject to attacks of fever), and acute malaria patients (those in the active phase of the fever attack), by means of blood analyses taken beginning with the onset of the attack (the first chills), then in the peak fever phase, and finally in the resting phase between acute attacks.

My subjects for this inquiry were fifteen cases of chronic malaria and 20 acute malaria patients.

Technique. -- After taking a 10cc sample of blood from the ulnar vein, I followed the Kramer-Tisdall method for determining the Potassium level in the centrifuged serum.

In a centrifuge tube, place 1cc of blood serum, and add to it, slowly, 2cc of reagent (solution of nitrite of cobalt), mixing thoroughly. After 45

minutes, pour into the test-tube 2cc of distilled water, shaking well, centrifuge for 30 minutes, then carefully pour off the liquid that has risen to the top of the precipitate, leaving about 0.3cc. Turn the test-tube so that the sides are coated by 5cc of distilled water, in such a way as not to disturb the centrifuged portion, then centrifuge again for five minutes, repeating the washing operation again until such time as the liquid atop the precipitate is absolutely clear. Decant it all, and add to the precipitate an abundant quantity of N/100 solution of potassium permanganate (about 2cc) then 1cc of 4/N sulphuric acid, mixing the precipitate well, clear to the bottom, so as to dissolve it completely. Heat it for 1.5 minutes in a boiling bath, until the color stops changing, and remains pink. If the pink color disappears, add more permanganate solution, and put the sample back in the boiling bath until the color stays pink. Then add to the test-tube enough N/100 oxalic acid (about 2cc) to remove the color entirely. Any excess oxalic acid may be removed with N/100 solution of potassium permanganate, which should be added until a pale rose color appears and lasts for one minute.

Calculate: the number of cc's of permanganate solution needed (subtracting, of course, the cc's of oxalic acid), multiplied by 7.1, will give the amount of Potassium (in milligrams) in 100cc of serum.

A) CHRONIC MALARIA

Case No. 1: D.C., age 25, contracted malaria at age 2, had occasional attacks in the following years. Was treated with arsenicals, because of a hematuria reaction to quinine. Potassium blood level: 29.67mg%.

Case No. 2: M.S., age 53, suffered from relapsing autumnal malarial fever from age 13; latest fever attack two months previously. Shows a slight degree of anemia and a small tumor of the spleen. Potassium blood level: 30.77mg%.

Case No. 3: C.M., age 33. Suffered for a year with intermittent fever, which yielded to a quinine treatment; no attacks of fever for a month and a half. The spleen, with an inferior pole, reaches the umbilical transverse. Red corpuscles 2,200,000. Hemolog. 50%. Glob. val. 1.1. Potassium blood level: 14.37mg%.

Case No. 4: S.A., age 20. Has suffered for some ten years with a tertian malarial fever with summer recurrences. High degree of anemia, spleen swollen so as to protrude five fingers beyond the rib cage. Red corpuscles, 1,360,000. Hemolog. 15%. Glob. val. 0.58. Potassium blood content: 16.92mg%.

Case No. 5: N.G., age 18. Contracted malaria at five. Has suffered fever attacks of the tertian type for the last four months. Semilunar corpuscles present. Has had no fever for one month. Spleen protruding beyond rib cage to a distance of two fingers. Potassium blood level: 29.41mg%.

Case No. 6: M.S., age 15. At fourteen, suffered quotidian fever attacks, preceeded by chills. Diagnosis of malarial infection made at the clinic on the basis of tertian summer-autumn parasites. Treated with arsenic and quinine, has had no rise in temperature for a month. Slight swelling of the spleen. Potassium blood level: 32.47mg%.

Case No. 7: F.G., age 27. At seventeen, stricken with malaria. Attacks were frequent in the subsequent years. Has had no rise in temperature for the last two months. Spleen swollen and protruding four fingers beyond the rib cage. Red corpuscles: 1,150,000. Hemoglobin 53%. Glob. val. 1.8. Potassium blood level: 17.32mg%.

Case No. 8: M.G., age 19. Has had malaria from the age of ten. Every autumn, has renewed attack. Slight swelling of the spleen. Potassium blood level: 33.7mg%.

Case No. 9: S.G., age 15. Contracted malaria nine months ago, was treated with quinine. Attacks recurred after four months. Has had no rise in temperature for 25 days. Spleen swollen and protruding two fingers beyond the rib cage. Potassium blood level: 34.11mg%.

Case No. 10: T.M., age 39. Has had malaria since the age of eight, with recurrent attacks every summer despite intensive arsenic-quinine treatments. For the last three months, has had no rise in temperature. Spleen protruding some three fingers beyond the rib cage. Potassium blood level: 34.11mg%.

Case No. 11: C.G., age 53. Has had malaria since age 35. Has had no fever for the last three months. Potassium blood level: 29.09mg%.

Case No. 12: S.F., age 34. Has had malaria since childhood, with attacks at 25, 27 and 32 years. Four months ago, was stricken with tertian attack. For some forty days has had no fever. The spleen, with an inferior pole, reaches the umbilical transverse. Potassium blood level: 29.27mg%.

Case No. 13: M.M., age 21. Has had malaria since infancy. For the last five months, has had no rise in temperature. Has a swollen spleen, which almost reaches the umbilical transverse. Potassium blood level: 28.59mg%.

Case No. 14: D.M., age 18. First attacks of fever date from three years ago. Has had recurrent attacks since. No fever for the last four months. Slight swelling of the spleen and mild anemia. Potassium blood level: 26.31mg%.

Case No. 15: S.S., age 21. Has had malaria since infancy. Attacks of fever recurred despite all experimental treatment. Spleen at the umbilical transverse, high degree of anemia with presence of the mature form of the red series. Red corpuscles, 800,000. Hemoglobin 23%. Glob. val. 1.4. Potassium blood level: 16.32mg%.

According to the data gathered, the potassium level in chronic malaria shows no variation, and remains well within the limits of the physiological norms encountered by me. In cases of severe anemia induced by chronic malaria, the potassium level never reaches the minimum normal level, but remains from two to 4mg% below it.

B) ACUTE MALARIA

All subjects from whom samples were taken were suffering from malignant tertian forms of malaria, with the presence in the circulatory system only of small rings of Plasmodium praecox.

The results of my inquiry are summed up in the following table.

PATIENT	STAGE	POTASSIUM LEVEL (in milligrams per cc of blood serum)
1. C.M.	Chills	24.15
	Fever (39.6)	24.35
	Quiescent phase	24.28
2. F.G.	Chills	24.52
	Fever (40.3)	28.25
	Quiescent phase	24.75
3. D.G.	Chills	23.15
	Fever (39.8)	26.38
	Quiescent phase	22.31
4. S.B.	Chills	28.47
	Fever (39)	33.18
	Quiescent phase	26.49
5. L.Z.	Chills	34.38
	Fever (38.7)	36.21
	Quiescent phase	34.36
6. M.A.	Chills	35.39
	Fever (40.1)	40.26
	Quiescent phase	35.91
7. S.S.	Chills	-----
	Fever (37.8)	36.21
	Quiescent phase	30.18

PATIENT	STAGE	POTASSIUM LEVEL (in milligrams per cc of blood serum)
8. P.G.	Chills	-----
	Fever (40.8)	39.27
	Quiescent phase	36.18
9. A.C.	Chills	-----
	Fever (40.1)	39.27
	Quiescent phase	33.41
10. L.M.	Chills	36.47
	Fever (38.9)	38.25
	Quiescent phase	36.50
11. C.L.	Chills	-----
	Fever (40.5)	41.13
	Quiescent period	35.27
12. M.T.	Chills	25.24
	Fever (39.1)	30.31
	Quiescent period	26.47
13. D.A.	Chills	-----
	Fever (39.3)	40.57
	Quiescent period	34.26
14. P.V.	Chills	-----
	Fever (40.5)	29.82
	Quiescent period	26.32
15. D.G. M.	Chills	-----
	Fever (38.6)	27.36
	Quiescent period	26.11
16. P.G. M.	Chills	-----
	Fever (38.9)	34.25
	Quiescent period	30.30
17. F.G.	Chills	29.21
	Fever (38.4)	32.66
	Quiescent period	28.55
18. C.S.	Chills	-----
	Fever (38.7)	38.26
	Quiescent period	34.77

PATIENT	STAGE	POTASSIUM LEVEL (in milligrams per cc of blood serum)
19. D.G.	Chills	-----
	Fever (39.3)	27.43
	Quiescent period	23.38
20. P.B.	Chills	24.63
	Fever (38.3)	29.16
	Quiescent period	25.87

In acute malaria, the potassium content of the blood rises during the feverish phase of the attack. During the quiescent phase, the potassium levels drop back to almost the same as those noted during the initial phases (chills) of the attack.

Sometimes (see cases numbered 6, 8, 9, 10, 11 and 13) the potassium level during the fever stage is higher, in absolute figures, than the normal maximum limits found in those cases showing an already high potassium level, although still within the normal physiological limits.

Tests taken fifteen days after the final fever attack show no variation in the potassium level from that recorded during the quiescent phase. Body temperature does not have any apparent effect on the potassium-level rise. Control experiments have proven to me that in many morbose conditions the potassium level in the blood serum shows no correlative variation pattern with changes in body temperature. In other words, the potassium level remains fairly constant when there is fever, whether the fever be slight or high.

* * *

In conclusion, we can say that: 1) In severe anemia of malarial origin the potassium level in the blood serum drops below the normal minimum level. 2) In chronic malaria, with mild anemia, there is no variation from the normal physiological levels. 3) In acute malaria, during the fever phase, there is an increase in the potassium level. This increase is not apparently linked with the fever as such. During the quiescent periods, the potassium level returns to normal.

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